Sharing Contracted Resources for Fire Suppression: Engine Dispatch in the Northwestern United States

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Abstract

As demand for wildfire response resources grow across the globe, a central challenge has been to develop new systems and capacity to ensure that resources needed for fire response are in the right place at the right time. Private contractors have become increasingly important in providing equipment and services to support agency wildfire suppression needs in the U.S. Understanding the capacity of contracted resources for federal agency fire suppression needs is critical for preseason fire planning and response. Using data from the National Resource Ordering and Status System, we examined how engines were dispatched from the Northwest region from 2008 to 2015. Results indicate that the number of times and days engines were out on assignments increased over the study period, and dispatch centers routinely shared engines outside their assigned areas, both within and outside their geographic area. However, in 2015, not all of the available engines were utilized at peak demand during one of the largest fire seasons in the Northwest. This study provides insight into the ways in which fire mangers share important resources such as engines and raises questions about what is the right amount of capacity needed to be able to respond in extreme fire years.

Brief summary

We examined private engine dispatch patterns in the Northwest U.S. from 2008-2015. We found that contracted engines were used more often and more intensively over the 8-year period. However, in 2015, only 71% of engines were utilized at peak demand during one of the largest fire seasons in the Northwest.

Introduction

As demand for wildfire response resources grow across the globe, a central challenge has been to develop new systems and capacity to ensure that the resources needed for fire response are in the right place at the right time. This is particularly crucial as wildfire seasons have generally grown longer while maintaining (and perhaps increasing) their erratic nature, both between and within seasons (Luo *et al.* 2013; Jolly *et al.* 2015). Although 98% of United States wildfires are successfully suppressed before they reach 120 hectares, the remaining 2% account for 97% of the total costs of firefighting and area burned (Calkin *et al.* 2005; North *et al.* 2015). In this context, there is a significant need for resources that can be called upon when needed but may not actually be needed all that often. To limit the amount of resources standing idle requires having systems in place to efficiently move resources across large geographic areas as demands ebb and flow.

Incident management systems around the world have been focusing on improving decision-making, support tools, and pre-positioning and planning (Pacheco *et al.* 2015). In the U.S., federal agencies have developed a national interagency fire system that coordinates public- and private-sector resources at various geographic scales, and increasingly emphasizes the role of non-federal resources for fire suppression (Booz Allen Hamilton 2012; NIFC, 2015). This wildfire suppression organization includes a military-like hierarchy of fire managers, equipment, crews, and coordination and dispatch centers (Lueck 2012). At the sub-regional level are dispatch centers, which fill resource orders for individual fires occurring within their host dispatch area. If they do not have the necessary resources, they call upon their Geographic Area Coordination Center (GACC) to fill resources from other dispatch centers in the Geographic Area (GA). If a geographic area does not have the necessary resources within its region, it calls upon the National Interagency Fire Center (NIFC) to obtain resources from other geographic areas. Over the course of the year, resources may move around their region or across the country as fire demands shift. In this system, each dispatch center, geographic area coordination center, and NIFC are responsible for both filling and requesting resources.

Fire managers must plan for both the resources needed locally to quickly respond to fires during initial attack, as well as for the small number of fires that will require extensive resources. Federal agencies and fire managers are tasked with the added complexity of anticipating resource needs in the coming days and weeks across the nation. This means that federal agencies must consider preseason and fire season capacity for local, regional, and national needs and existing agreements with state and local government cooperators and private contractors to ensure that resources will be available when and where they will be needed.

In the western United States, much of the wildfire response falls upon federal and state land management agencies due to the large amount of public land. There is a long history of using federal employees and equipment as the backbone of wildfire response efforts with support by state and local cooperators, as well as private businesses (Donovan 2005). Increasingly, the federal government is relying on private sector resources for fire response (GAO, 2007; Booz Allen Hamilton 2012; GAO, 2015). With government resources, agencies can centrally dictate where resources will be located. However, with private sector resources, agencies must create procurement systems, contractual terms and conditions, and financial incentives to both attract and constrain companies. Market dynamics and business interests will also necessarily play a part in the particular capacity that is available in any given location.

To increase certainty of having qualified equipment available in an orderly manner, and to respond to issues of fire contracting efficiency, the Forest Service began using the Virtual

Incident Procurement (VIPR) system in 2009 to solicit, award, and manage preseason agreements with contractors for equipment and certain types of services (USFS, 2015b). Once a contractor's piece of equipment has been approved, the contractor is issued a preseason agreement and the equipment is placed on a Dispatch Priority List (DPL) for a particular host dispatch center based on the equipment's location (USFS, 2015a). Under the current system, any piece of equipment that meets specifications will be placed on the appropriate DPL. Dispatch centers call contractors when they need specific resources, but contractors do not necessarily have to accept a given assignment.

To date there has been limited research on federal procurement practices and related impacts on market efficiencies or businesses (Caldwell *et al.* 2005), or incident command systems more broadly (Jensen and Thompson 2016). Recent research suggests fire suppression contracting capacity varies considerably across the American West (Nielsen-Pincus *et al.* 2013, 2014). The evolution in the systems for managing wildfire resources in the U.S. and the growing dependence on the private sector capacity raises urgent questions about whether and how this system is creating and sharing private sector capacity. To address this issue, this paper asks two key questions: (1) How are private sector resources deployed across dispatch centers to meet demand? and (2) How does private sector capacity compare to the demand for resources over the course of a fire season?

To answer the first question, we examine the deployment of engines from dispatch centers in the Northwest Geographic Area (Oregon and Washington) from 2008 to 2015. The Pacific Northwest has a long history of significant private sector forestry services contracting (Moseley *et al.* 2014) and in 2015 had the most pieces of equipment under preseason agreements in the West, including 25% of all engines, which is one of the largest equipment categories across all GAs (Huber-Stearns *et al.* in review). To answer the second question, we focus on private sector engine capacity and deployment in the Northwest GA in 2015. The 2015 fire season in Oregon and Washington was recently noted by the U.S. Forest Service as “the most severe fire season in modern history” (USFS 2016) and provides a case example to compare capacity to peak demand.

Methods

Data sources

U.S. Forest Service Region 6 Fire and Aviation Contracting Team provided data on private contractor engine dispatches for the Northwest Geographic Area (GA) from the Resource Ordering and Status System (ROSS) for 2008-2015. ROSS data includes information about both the host and requesting dispatch centers, equipment type, business (e.g., company name), and incident information (e.g., name of fire, mobilization and demobilization dates). This data only tells us when and where Northwest engines were dispatched, so we cannot speak to the total number of resources called to a given incident. For example, we do not have data on federal or cooperator resources deployed in the area, or contract engines that may have come from a different GA to an incident in the Northwest.

Additionally, we obtained information on all private contractor engine types with preseason agreements in VIPR in 2015. Data included all vendors with preseason Incident Blanket Purchase Agreements for engines in VIPR in December 2015 (USFS, 2015b). The information in this data includes host dispatch center, agreement number, engine types (which differentiate specifications for engines), DPL ranking, company name, equipment location, and equipment specifications. Although this database only contains equipment listed in December 2015, this still largely represents what equipment was available in the 2015 fire season because preseason agreements for equipment are generally kept in the system until the following spring when contracts are reissued. Our database does not include incident-only emergency equipment rental agreements for engines, which are resources without preseason agreements and, thus, not included in VIPR.

[Figure 1 about here]

Procedures and analysis

We examined trends in engine use across the Northwest GA through descriptive statistics of the ROSS database. We conducted most analysis at the dispatch center level, because resource orders are made at that level. Engines were categorized as having been dispatched within their own dispatch center, to another dispatch center within the Northwest, or outside of the Northwest. The total number of engines shared between dispatch centers was then used to create a point map, where engine dispatch lines were drawn from each dispatch center weighted by the number of engines sent between locations.

Resource capacity was examined by comparing the available engines from preseason DPLs (i.e., supply) to resource orders from ROSS in 2015 (i.e., demand). Both sources contained identifying information for individual engines which allowed us to link the two datasets. Mobilization and demobilization dates from ROSS were used to calculate availability of engines by day. To further understand the details of engines dispatched during the 2105 fire season, we also compared dispatch information with fire reports from the time period and region of interest (USFS 2016).

Results

Between 2008 and 2015, the Northwest dispatched private engines 7,044 times to 739 fires. Over the eight-year study period, the number of times that engines were dispatched increased considerably while the total number of engines in the system and the number of businesses increased only slightly, suggesting that what engines there are in the system are being used with increasing frequency (Figure 2). The number of days that engines were out on assignment also increased, from an average of five days in 2009 and 2010 to ten days in 2015 ($F = 82.16$, $p < .001$). With the increase in the number of times engines were dispatched came a growth in engines dispatched outside of the Northwest GA (Figure 3). This growth was particularly evident in larger fire years, such as 2012.

[Figure 2 about here]

[Figure 3 about here]

Temporally, engines were dispatched in similar patterns year to year, with initial dispatches starting in mid-May to June and peaking in August (Figure 4). Overall, dispatch centers were more likely to use their own engine resources earlier in the season and share more resources as the season progressed.

[Figure 4 about here]

Sharing engines

All dispatch centers with engines sent them outside their host center at least once during the study period, although most stayed within the Northwest GA. Thirty-four percent of engines were dispatched to fires within their host center and 55% went to another dispatch center within the Northwest. The remaining 11% of dispatched engines were sent to 33 other dispatch centers in the western U.S. Engines dispatched outside of the Northwest were primarily dispatched to Northern California and Great Basin, and to a lesser degree, Rocky Mountain, Northern Rockies and Southern California GAs.

Of the engines dispatched within the Northwest, 11% were sent to the Oregon Department of Forestry or Washington Department of Natural Resources. The remaining 89% of engine dispatches were sent to 17 dispatch centers. Fourteen of these dispatch centers were interagency and both sent and requested resources. The other three dispatch centers were on tribal land and received but did not send resources. Coastal Valley sent engines to other locations but never used any themselves and Coos Bay and Roseburg Dispatch Centers never requested resources.

Looking at individual dispatch centers and their patterns of sending and receiving engines, we can see that there is considerable variability across the Northwest GA (Figure 5). Some dispatch centers were able to meet much of their resource needs internally whereas others were more dependent on other centers for their engines. For example, the Blue Mountain Interagency Dispatch Center was able to cover 79% of their engine needs with their own contract engines whereas Northeast Washington and Umpqua were only able to cover 23%.

In addition to meeting their own resource needs, Blue Mountain provided engines to many other places across the Northwest, especially to their close neighbors. Central Washington mostly shared engines with their neighbors whereas others including Central Oregon, Lakeview, and Vale shared resources more widely. Another group of dispatch centers, including Burns, for example, provided relatively few engines and were more dependent on engines from other centers. Although we do not have preseason agreement equipment numbers for 2008-2014, comparing these patterns to 2015 equipment data suggests that the number of engines shared seems to largely reflect the amount of equipment available as well as their location within the geographic area as a whole.

[Figure 5 about here]

Engine capacity compared to demand in 2015

We examined how engine availability compared to demand over the 2015 fire season by comparing engines on the dispatch priority lists to those that were actually dispatched. In 2015, 14 of the 20 interagency dispatch centers in the Northwest dispatched engines. Of those centers with engines, the number of engines ranged from two in Puget Sound to 67 in Blue Mountain. On average, dispatch centers had 28 engines.

There were 387 engines with preseason contracts belonging to 129 businesses across the 14 dispatch centers. Of these 387 engines, 345 engines were dispatched a total of 1,548 times (Table 1). The remaining 42 engines were never dispatched in 2015. We do not know why they were never dispatched but reasons could include that they were never needed or because they were listed as local fires only (e.g., no out of area calls), were without a certified driver, being repaired, or owner declined all calls.

The 2015 fire season for engines in the Northwest GA started on June 10, when the first engine was dispatched, and concluded on October 16, when the last engine was demobilized. The number of engines dispatched on any given day during the fire season varied, with the largest number of engines being dispatched from early August to early September. There were some differences in patterns between dispatch centers with small or large numbers of resources. Only two dispatch centers – Vale, which had 22 engines, and Puget Sound, which had 2 engines – had days in the 2015 fire season where all their engines were dispatched. On the other end of the range, four dispatch centers had at least 10 or more unassigned engines even during their peak engine use. The percent of days in the fire season with no engines assigned ranged from 11% in Central Washington to 61% in the Central Valley, with an average of 33% days with no engines assigned. The dispatch centers with the fewest number of resources had the largest portion of the fire season without any engines dispatched. For example, Puget Sound and Central Valley, with few engines spent over 50% of the fire season without dispatching any of their engines. Comparatively, the centers with the most engines had the fewest number of days with no engines assigned (Table 1).

[Table 1 about here]

Engine dispatch during peak period in 2015

During the peak period from late July to early September 2015, the pattern of where resources were sent shifted over time. At the beginning of the peak season, engines were dispatched within centers and between centers within the Northwest, but with a considerable proportion of resources outside the GA. However, as the peak season progressed, the number of engines were increasingly being dispatched within the GA, so that by the end of August virtually all resources were dispatched within the GA but outside of host centers.

August started off with more than one-third of the Northwest engines being sent to a string of fires in northern California between August 1 and August 9 where they were on assignment an average of 12 days. On August 10, Northwest engine dispatches shifted exclusively to the Northwest. Many of the engines returning from early August California fires were immediately dispatched to Northwest fires (within two days). The day with the most engines out on fires for engine dispatches in the Northwest was August 10 with 71% of the engines out on fires (Figure 6). The most engines were dispatched to the Corner Creek Fire in Oregon (58 engines, started June 29) and the Blue Creek (59 engines, started July 20) and the Okanogan Complex (81 engines, fires started on August 13 and 14 and were placed in a complex on August 17) fires in Washington.

Overall, the largest proportion of mobilizations in August occurred for two key fires: (1) the Canyon Creek fire in the John Day dispatch center and (2) the Okanogan Complex fire in the Northeast Washington dispatch center. These were two of the largest fires in the 2015 fire season in the Northwest, initiated by lightening strikes just days apart, on August 12 and 16 (USFS 2016). In total, 129 engines were assigned to these two fires between August 14 and September 30.

John Day supplied half of their own engines for the Canyon Creek Fire. The rest came from eight dispatch centers across Oregon, four of which were dispatch centers bordering John Day. Engines were on assignment an average of 14 days and a maximum of 31 days.

Northeast Washington did not supply any contract engines on the Okanogan Complex, although they supplied engines to other fires in their area as well as to Colville. More than one-third of engines sent to the Okanogan Complex were from neighboring Central Washington. Other engines came from nine dispatch centers, eight of which were from Oregon. Engines were on assignment an average of 16 days with a maximum of 37 days.

[Figure 6 about here]

Discussion

This study provides insight into the ways in which fire mangers share important resources such as engines and raises questions about what is the right amount of capacity needed to be able to respond in extreme fire years. Mangers would want to have a gap between available resources and resources used in a given fire season, as a buffer is critical for response to extreme events. An open question is whether there are enough (or perhaps too many) engines in the Northwest. On the one hand, even on the peak day in an historically bad fire year, nearly 30% of engines were not dispatched, so perhaps the Northwest does have excess engine capacity. Moreover, at a time when the entire west was limited in their ability to obtain sufficient resources, some 12% of engines in the Northwest went entirely unused. We do not know from our data whether some or all of these resources were in fact not really available for some reason or whether these engines were idle as backup. On the other hand, the Northwest region is using its engines increasingly intensively. The number of days that engines are out on assignments has steadily increased since 2009. Moreover, engines are increasingly being sent outside of the Northwest, suggesting that other geographic areas are dependent on Northwest engines.

In mid-August for 10 days the number of large fires in the Northwest combined with the high numbers of fires in the Northern Rockies and Northern California created a situation where fire managers were limited in their ability to "rapidly obtain Initial Attack reinforcements as well as almost all types of firefighting resources needed for Large Fires." (USFS, 2016, p. 7). This was the kind of fire season that managers plan for – the one fire in the one year with the few days when resources are stretched too thin. Having more resources in this scenario more might mean the difference between a short or long fire (the difference between a fire in the 98% of successfully suppressed small fires versus one of the 2% fires accounting for 97% of suppression costs). Planning for rare, extreme fire years means that in other years, resources will go unused. While we do not know what amount of a buffer is appropriate, this provides agencies a starting point to consider how their preseason solicitations align with resource use. Specifically, what equipment is solicited and where has implications across geographic scales. At the local level, available resources impact initial attack capacity, and at the regional and national level this impacts extended attack capacity. Additionally, depending on how many of the excess engines were actually available, and not out of service for a variety of reasons, the relatively small proportion of engines left is particularly notable as the Northwest GA contained 24% of all contract engines in the seven western GAs (where the majority of contract resources reside for the nation) in 2015.

How preseason solicitations are conducted also impacts agency ability to ‘pre-position’ contracted resources. Private sector engines are primarily dispatched and shared within the geographic area, which suggests an increased emphasis on the GACC-level decision-making. The flexibility demonstrated by dispatch centers in sending their engines to other regions and later requesting engines from their neighbors when fires struck in their own areas demonstrates flexibility and coordinated resource response at the dispatch center level.

These themes about needing excess capacity and flexibility in engine sharing have implications for resource sharing across all fire resources in this national system, and for other countries dealing with similar transitions in incident management systems for hazards. Federal-level systems are still linked to local capacity. Similarly, these points relate to incident management systems in the U.S. and more broadly: preparing for the unpredictable events means that buffers and flexibility and adapting to available and needed resources are necessary.

Conclusion

Our study shows that, in an unprecedented fire season, the Northwest used the majority of their contracted engine capacity, primarily through sharing of resources within the geographic area between dispatch centers, and particularly during the peak of the fire season. The geographic area also provided significant resources to other areas across the West before the Northwest season was in full swing. This flexibility in dispatch centers releasing engines to fires outside their area with the knowledge that they will be able to bring in other resources later if needed is critical.

As demands for wildfire response resources grow across the globe, the challenge of developing new systems and capacity can be better informed by closer reexamination of how these resources are used and shared over the course of a fire season, particularly during peak periods in extreme fire years. This is particularly important given the growing reliance on private contracting resources for fire suppression, as capacity depends not only on public sector contracting and dispatching processes but also private sector interest in participation in this system.

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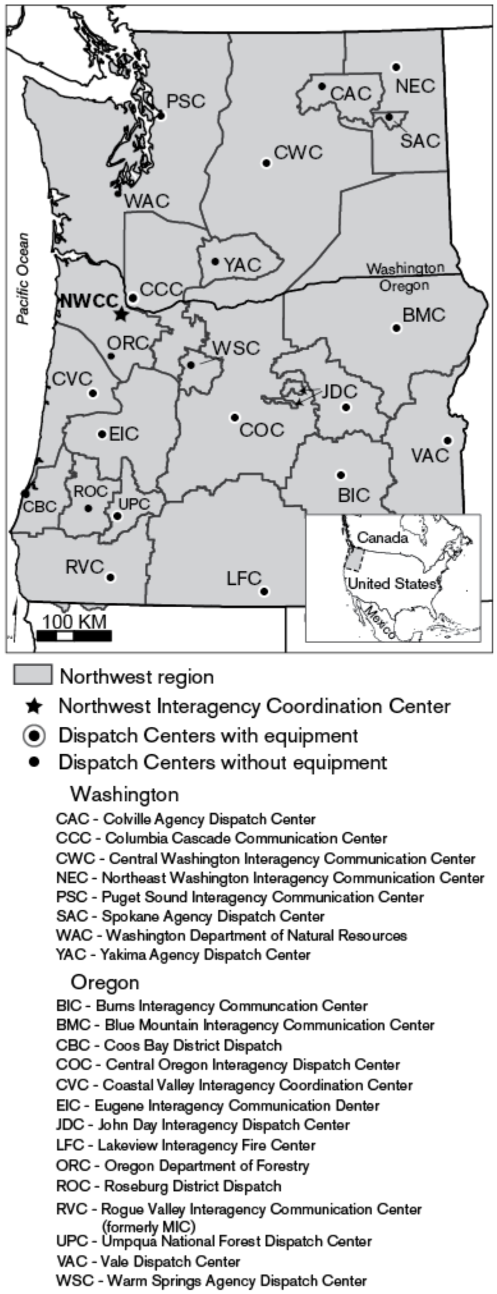


Figure 1. Dispatch centers within the Northwest Geographic Area.

Spatial data for the Northwest Geographic Area dispatch centers was provided by the Northwest Interagency Coordination Center in May 2016.

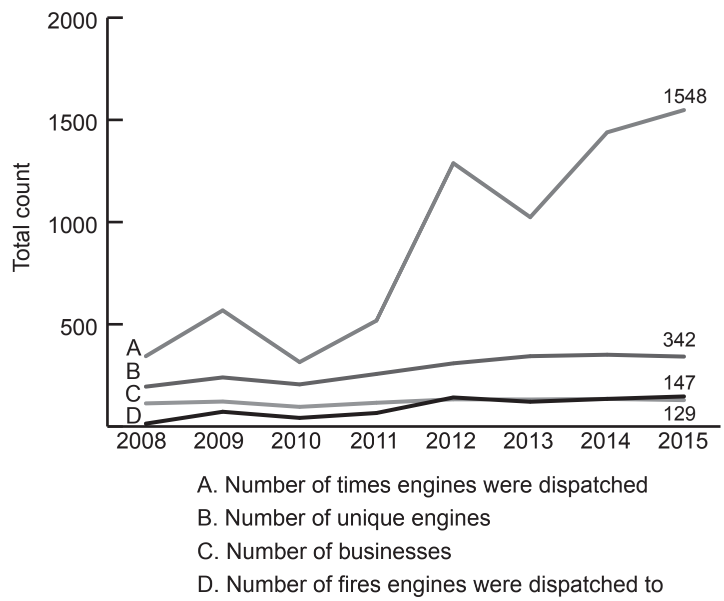


Figure 2. Total number of engines dispatched and fire incidents, 2008-2015

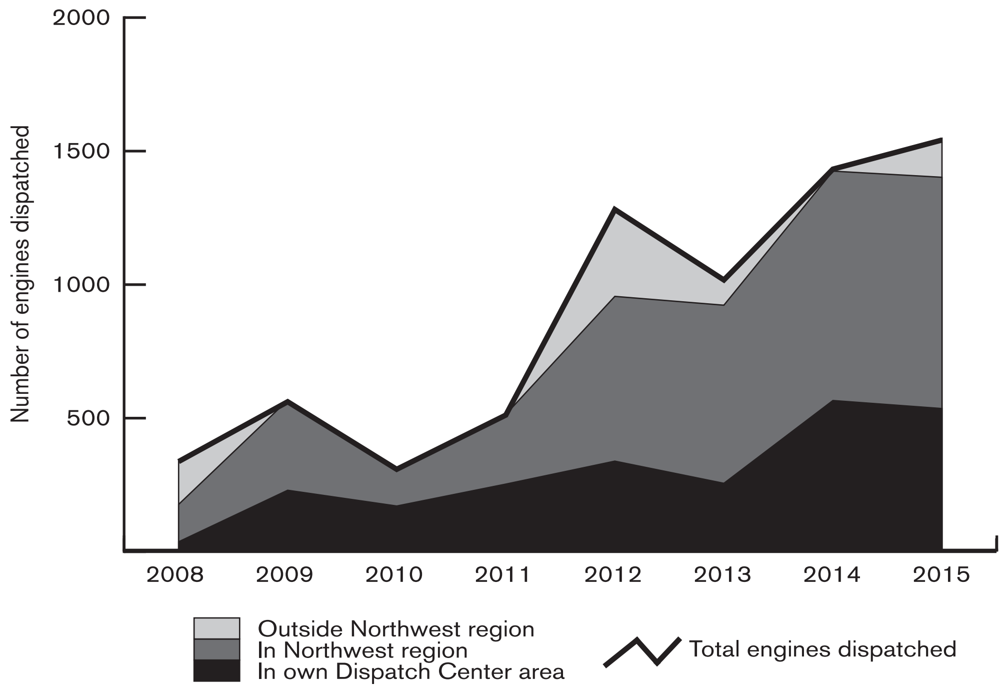


Figure 3. Number of engines dispatched in the Northwest from 2008-2015

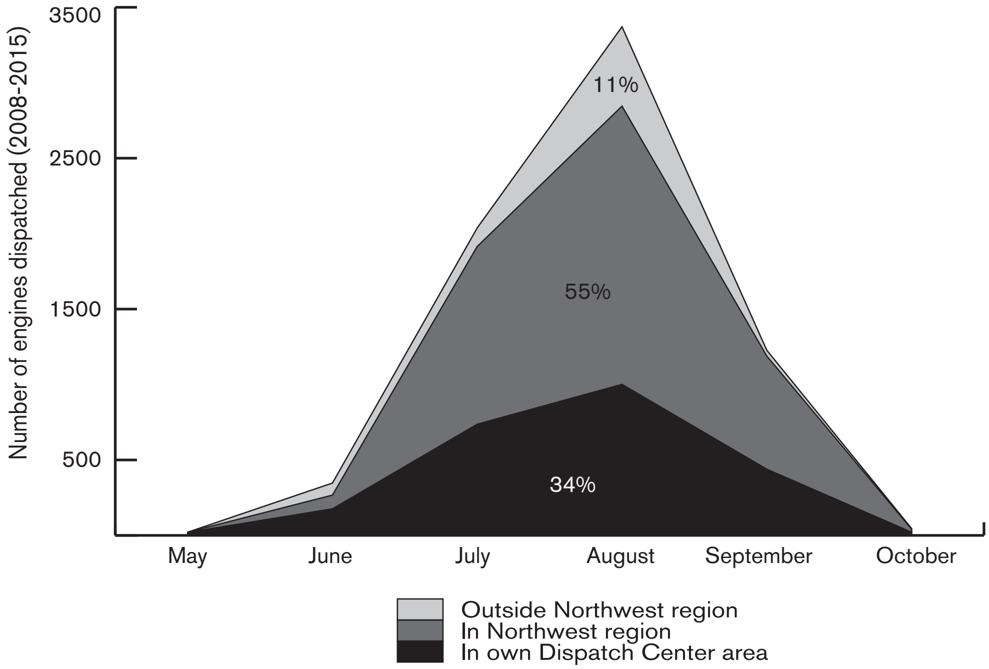


Figure 4. Engines dispatched by the Northwest Coordinating Center by month, 2008-2015

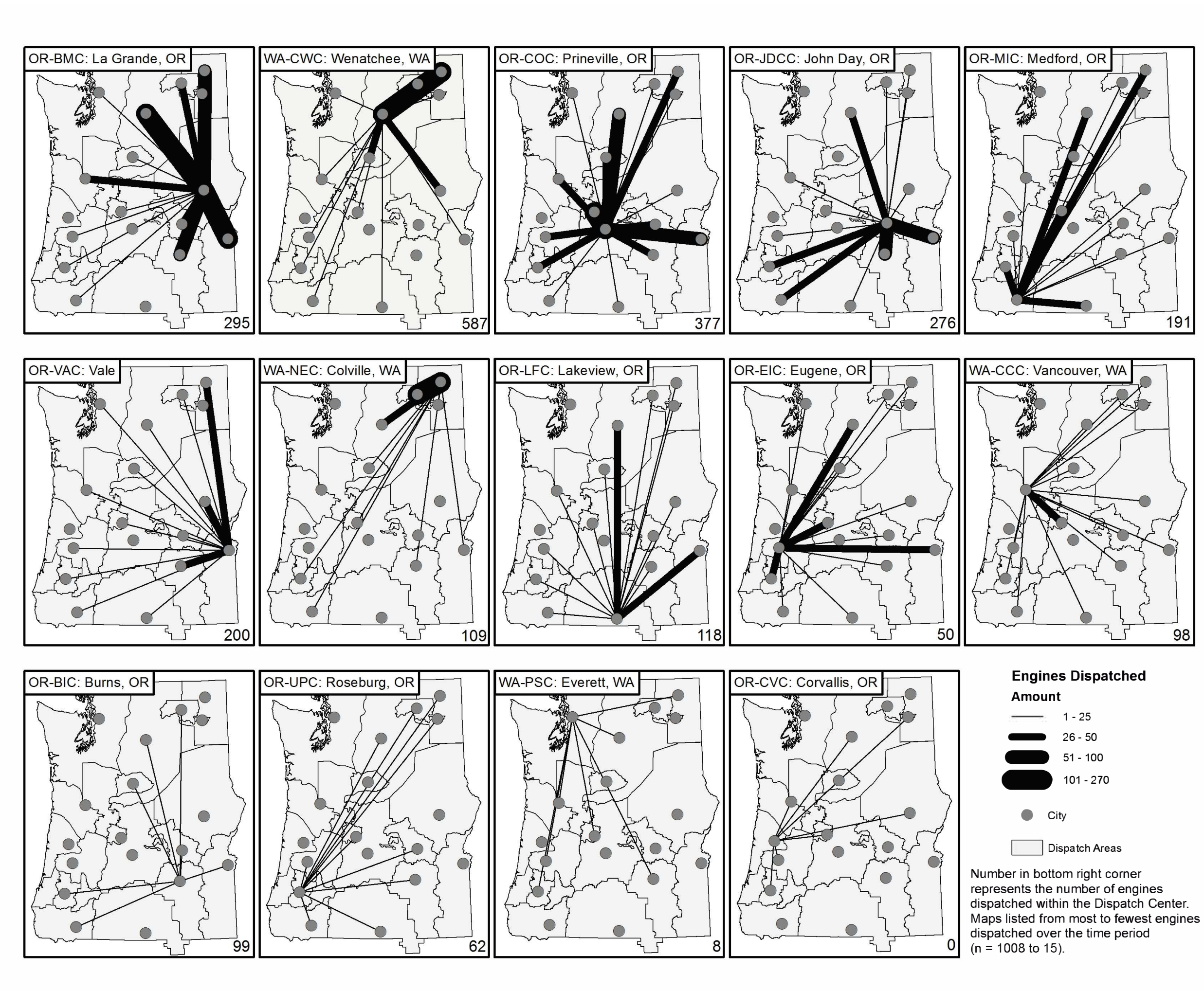


Figure 5. Northwest engine dispatches for fires by dispatch center from 2008-2015.

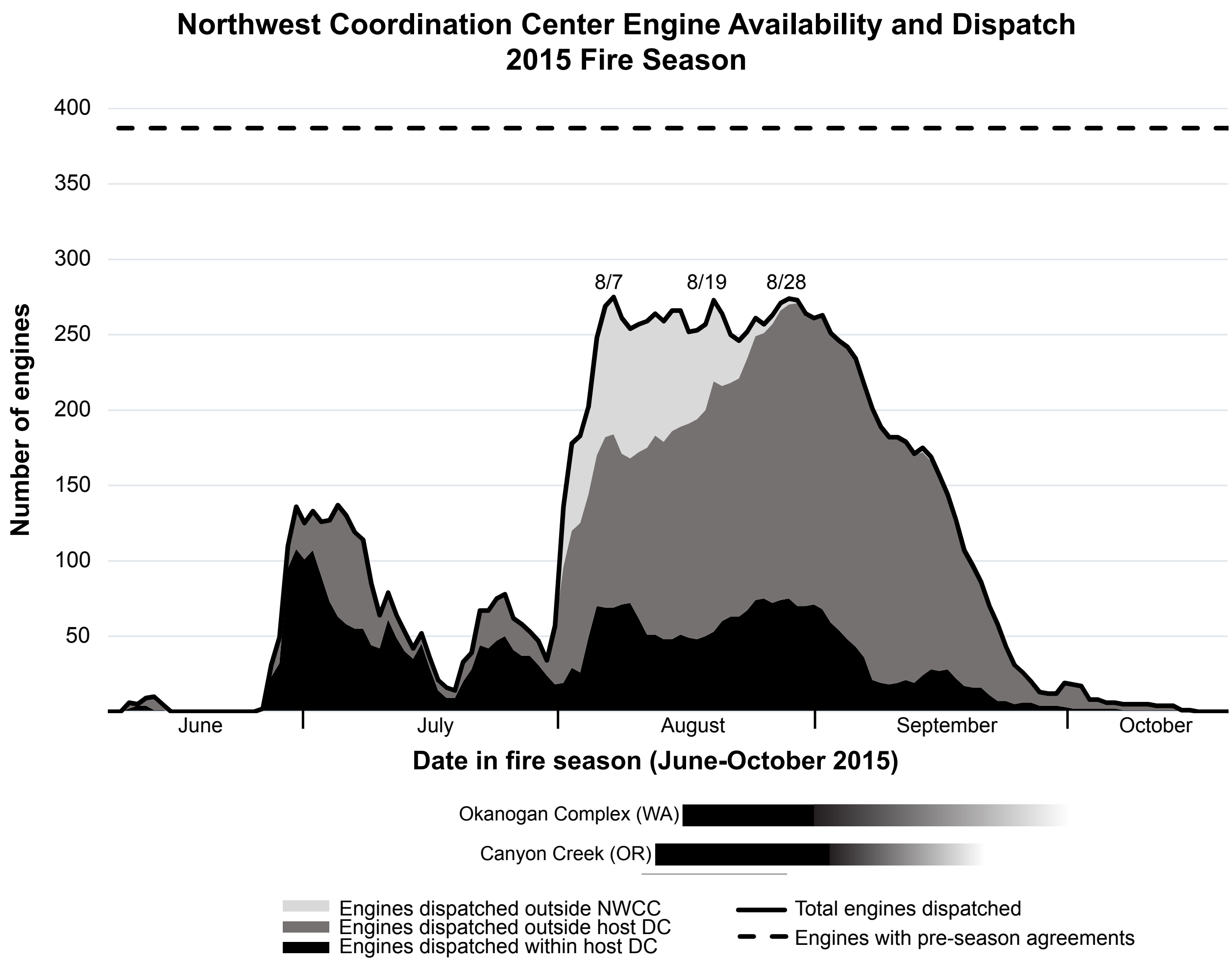
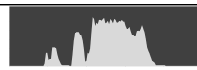


Figure 6. Northwest Coordination Center engine availability and dispatch during the 2015 fire season

Table 1. Engine availability and dispatches by dispatch center, 2015

Dispatch Center	**Total engines**[1]	**Graph of dispatches June 1---Oct 31**	**Minimum # of unassigned engines**	**Percentage of days with no engine dispatched**[2]
OR-BMC	67		12	23%
WA-CWC	57		6	11%
OR-COC	53		14	20%
OR-RVC	49		10	22%
OR-EIC	29		13	34%
OR-JDCC	28		2	26%
OR-LFC	24		7	45%
OR-VAC	22		0	26%
WA-CCC	21		8	29%
WA-NEC	16		7	35%
OR-UPC	9		3	30%
OR-BIC	7		1	47%
OR-CVC	3		1	61%
WA-PSC	2		0	58%

[1] Total number of engines with preseason agreements for engines in the Northwest in 2015
[2] In 2015, the "fire season" ranged from June 10 (date of first engine mobilized) to October 16 (date of last demobilization) = 152 days